2.2 Agricultural Runoff Discharge

Agricultural development has also changed the natural landscape within the study area, and has likewise resulted in changes in the way runoff from the watershed responds to rainfall on its land surfaces. Replacement of pre-existing rangeland, forests, and wetlands with relatively open pastureland and well-drained citrus and vegetable croplands has led to increased runoff rates from the land surface. Like those for urban impervious land surfaces, these increased runoff rates have contributed to the excessive freshwater discharges to the estuary during periods of high rainfall. A detailed rainfall and GIS land cover model was used to estimate relative agricultural runoff discharge rates for the basins. As for the relative urban runoff discharge criterion ranking, rainfall conditions were estimated using rainfall monitoring data collected by both the National Weather Service and SFWMD, and monthly rainfall values were computed for each of the tertiary basins by applying mean monthly values from each of the monitoring stations using the same equation as used for the urban discharge above.

Agricultural runoff discharge was calculated by applying the tertiary basin- and monthly-specific rainfall estimates to a detailed GIS land cover and soil characteristics database that was developed for this project (PBS&J, Inc. 1999). Land cover was delineated as described for the urban runoff discharge criterion, and hydrologic soil groups were compiled from three county-specific soil surveys (USDA, 1984, 1984, and 1990).

Monthly-specific runoff discharge estimates were computed for each individual parcel of land within a tertiary basin. Discharge was computed using runoff coefficients (Appendix B) specific for south Florida, with variation by land use/cover and hydrologic soil group, and adjusted for wet or dry season conditions. Runoff discharge estimates for each individual agricultural land parcel within a tertiary basin were then summed across agricultural land use types to compute the total agricultural runoff discharge for that tertiary basin and month, as follows:

$$\hat{q}_{j,t} = \sum_{s=1}^{S} \sum_{l=1}^{L} A_{j,s,l} \; \hat{p}_{j,t} \; C_{s,l,t}$$

where: $\hat{q}_{j,t}$ = estimated total monthly runoff discharge in the t[th] month for the j[th] tertiary basin,

$A_{j,s,l}$ = area of soil type s in land use category l in the j[th] tertiary basin,

$\hat{p}_{j,t}$ = estimated total monthly precipitation in the t[th] month for the j[th] tertiary basin, and

$C_{s,l,t}$ = runoff coefficient for soil s and land use l in the t[th] month, with season-specific runoff coefficients for south Florida urban land uses.

The agricultural land use types used in this calculation are those assigned to rangeland, sugar cane, truck crops, improved pastures, citrus and other tropical fruits, sod farms, ornamentals, and confined feeding operations.

The tertiary basins were assigned relative ranks according to estimated total annual agricultural runoff discharge by summing across months. Table 2-3 presents these relative ranks; Table 2-4 presents the area-weighted relative ranks for agricultural runoff discharge. Figure 2-3 presents the results of the agricultural runoff discharge ranking of the 62 tertiary basins in the study area grouped as described previously into high, medium, and low impact basins. Figure 2-4 presents the area-weighted results of the agricultural runoff discharge ranking of the 62 tertiary basins in the study area.

Table 2-3. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for agricultural runoff discharge.

Secondary Basin	Tertiary Basin	Area (acres)	% Urban Land Use	% Agricultural Land Use	Agricultural Runoff (acre-feet/yr)	Rank
Imperial River	6	41568	3	25	15763	1
Estero River	8	27647	16	27	10283	2
Six-Mile Cypress Slough	4	18354	20	23	5357	3
Estero River	6	7467	15	27	2522	4
Imperial River	4	4695	30	37	2173	5
Six-Mile Cypress Slough	1	8345	29	15	1687	6
Ten-Mile Canal	8	1441	11	42	873	7
Six-Mile Cypress Slough	6	1968	13	27	652	8
Six-Mile Cypress Slough	3	3893	42	13	606	9
Ten-Mile Canal	6	1728	44	28	579	10
Estero River	5	2460	41	17	570	11
Hendry Creek	5	1874	27	29	526	12
Estero River	3	2699	14	15	490	13
Ten-Mile Canal	11	2569	42	12	455	14
Ten-Mile Canal	9	1266	53	24	408	15
Six-Mile Cypress Slough	5	653	14	29	335	16

The top ranked tertiary basins in the Estero Bay Watershed for agricultural runoff include three basins located in the eastern portion of the watershed that are larger than 18,000 acres in area, and have more that 20% of their land use in agricultural uses. These basins include TB 6 in the Imperial River Basin, TB 8 in the Estero River Basin, and TB 4 in the Six-Mile Cypress Slough Basin.

Priority tertiary basins are in the Imperial River Basin (two tertiary basins), the Estero River Basin (four tertiary basins), the Six-Mile Cypress Slough Basin (five tertiary basins), the Ten-Mile Canal Basin (four tertiary basins), and the Hendry Creek Basin (one tertiary basin). There are no priority tertiary basins with respect to agricultural runoff discharge within the Barrier Islands Basin, the Mullock Creek Basin, the Spring Creek Basin, or the Cow Creek Basin.

TB 6 in the Imperial River Basin is the lowest ranked priority basin with respect to urban runoff discharge (Table 2-1), while being the top-ranked basin with respect to agricultural runoff discharge. In the Estero River Basin, TB 8 is ranked second for agricultural runoff discharge, and first for urban runoff discharge (Table 2-1), with TB 4 in the Six-Mile Cypress Slough Basin ranked second for urban runoff discharge and third for agricultural runoff discharge. Seven priority basins with respect to agricultural runoff discharge are also priority basins with respect to urban runoff discharge.

The area-weighted rankings of the tertiary basins within the Estero Bay Watershed show that two of the top three ranked tertiary basins in the non-area-weighted rankings above are also in the top 25% of the tertiary basins in the area-weighted rankings. TB 6 in the Imperial River Basin and TB 8 in the Estero River Basin are ranked fourth and fifth, respectively, in the area-weighted rankings of agricultural runoff. TB 8 in the Ten-Mile Canal Basin and TB 5 in the Six-Mile Cypress Slough Basin both have runoff of more than 0.5 acre-feet/yr/acre.

Table 2-4. Relative ranks of the top 25% of the tertiary basins within the Estero Bay Watershed for area-weighted agricultural runoff discharge.

Secondary Basin	Tertiary Basin	Area (acres)	% Urban Land Use	% Agricultural Land Use	Area-weighted Agricultural Runoff (acre-feet/yr)/acre	Rank
Ten-Mile Canal	8	1441	11	42	0.60592	1
Six-Mile Cypress Slough	5	653	14	29	0.51273	2
Imperial River	4	4695	30	37	0.4629	3
Imperial River	6	41568	3	25	0.37922	4
Estero River	8	27647	16	27	0.37194	5
Estero River	6	7467	15	27	0.33781	6
Ten-Mile Canal	6	1728	44	28	0.33523	7
Six-Mile Cypress Slough	6	1968	13	27	0.33106	8
Ten-Mile Canal	9	1266	53	24	0.32244	9
Six-Mile Cypress Slough	4	18354	20	23	0.29188	10
Estero River	7	248	46	24	0.28643	11
Hendry Creek	5	1874	27	29	0.28084	12
Estero River	5	2460	41	17	0.23157	13
Six-Mile Cypress Slough	1	8345	29	15	0.20212	14
Estero River	3	2699	14	15	0.18168	15
Ten-Mile Canal	11	2569	42	12	0.17701	16

To provide a comparison with the area-weighted agricultural runoff from the basins in Table 2-4, values from drainage basins within the Charlotte Harbor National Estuary Program (CHNEP) study area may be used. The range of area-weighted agricultural runoff discharge from the major basins in the CHNEP study area was from 0.03 acre-feet/yr/acre (for the Lemon Bay Basin) to 0.34 acre-feet/yr/acre (for the Peace River Basin) (PBS&J and Bender, 1998). The area-weighted agricultural runoff from the entire Estero Bay Watershed is 0.25 acre-feet/yr/acre (Appendix A).

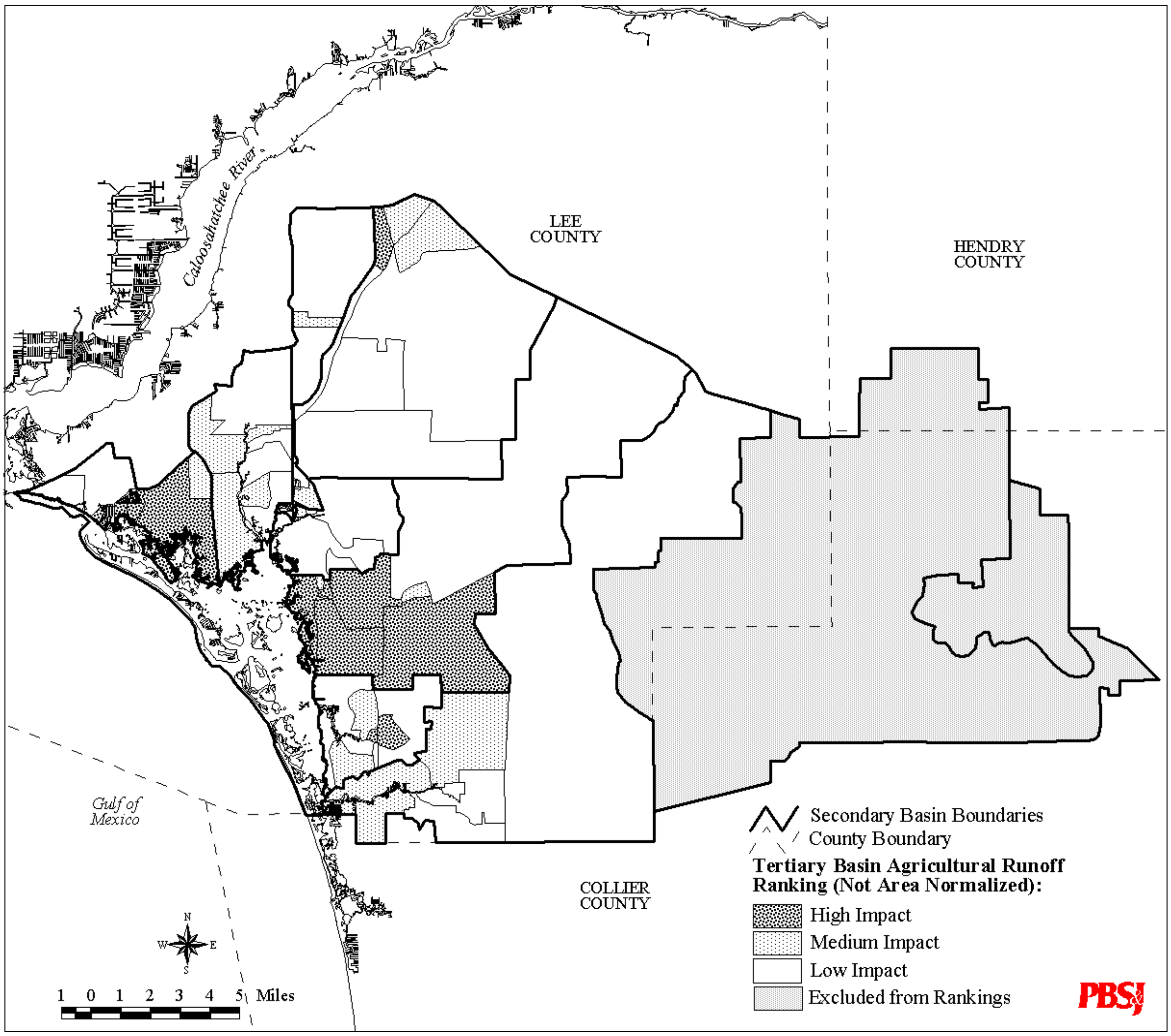

Figure 2-3. Tertiary basins classified by agricultural runoff discharge.

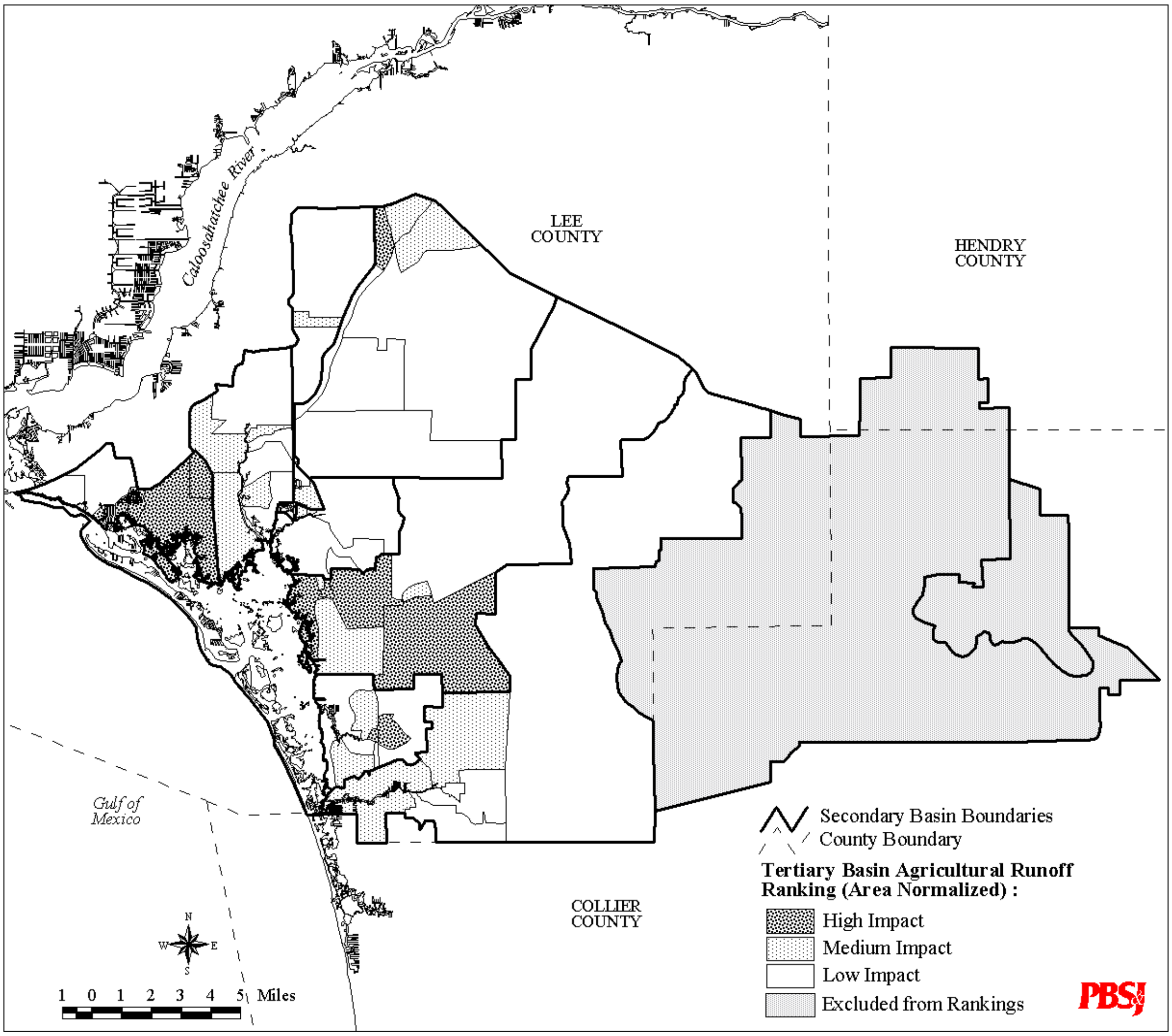

Figure 2-4. Tertiary basins classified by area-weighted agricultural runoff discharge.